

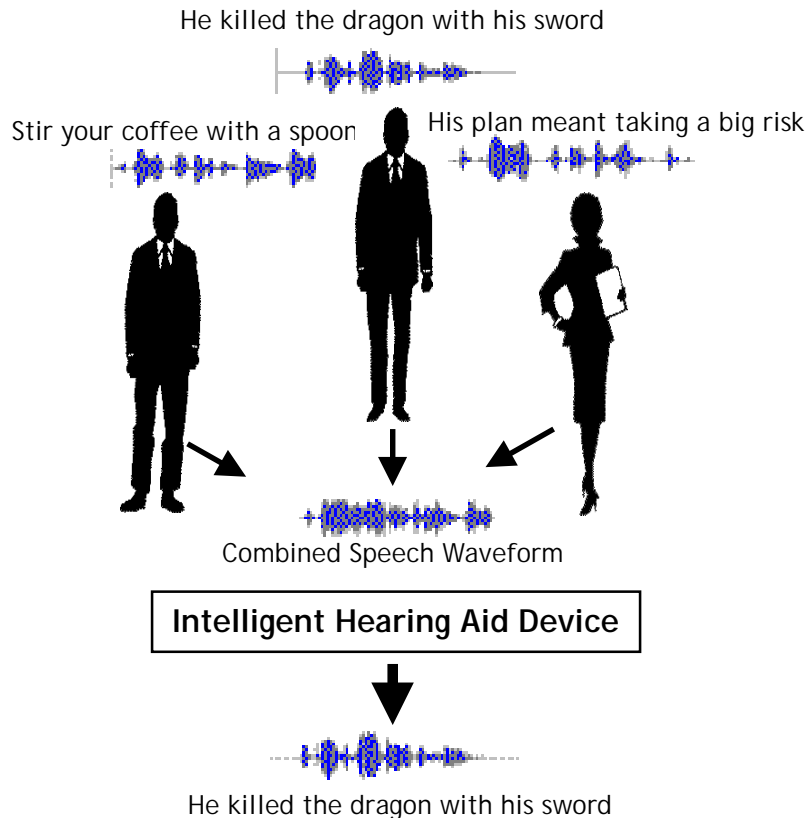


# Intelligent Hearing Aid Project

Beckman Institute  
University of Illinois at Urbana-Champaign

Douglas Jones

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W. O'Brien, C. Lansing, R. Bilger

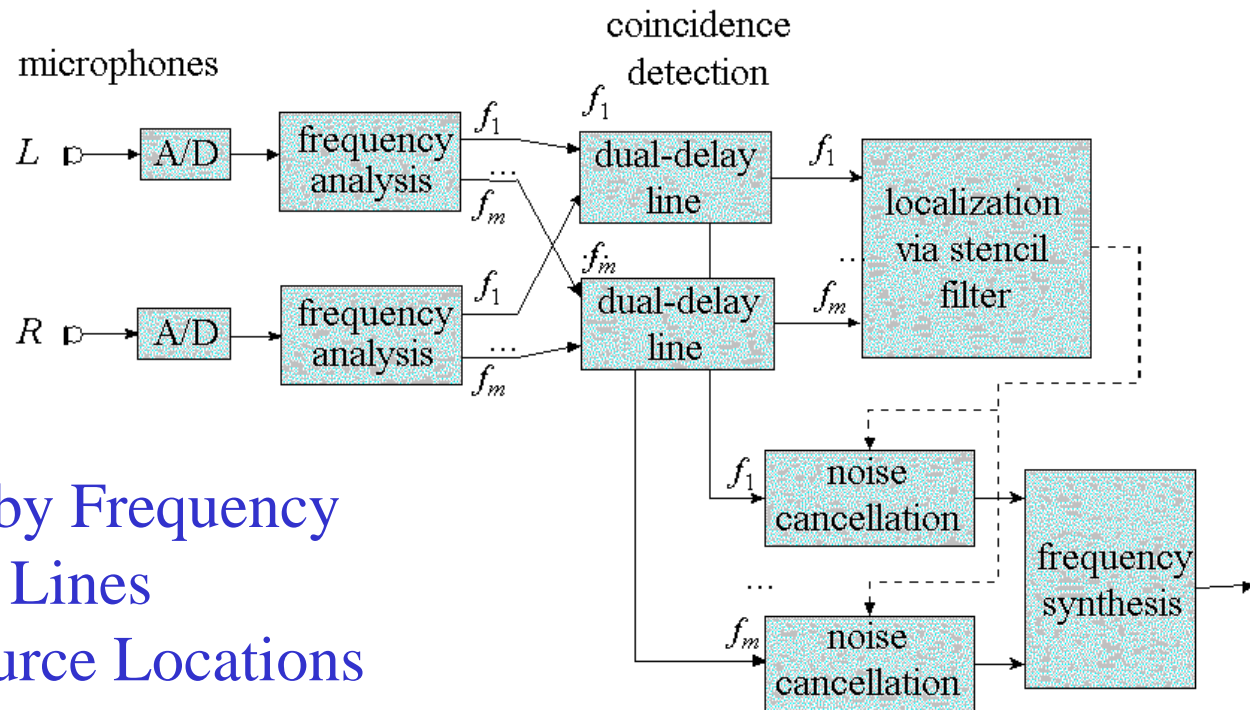


Goal:

Develop high performance auditory processors which can effectively extract a desired speech signal in the presence of multiple competing sounds.

# Algorithm 1:

## Localization and Cancellation

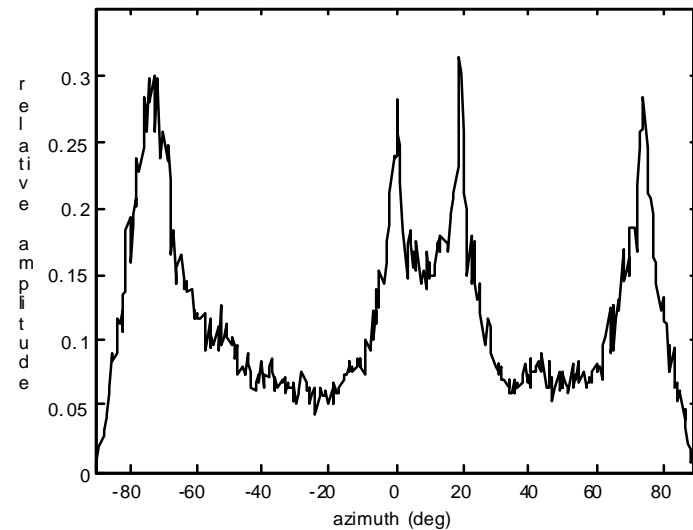
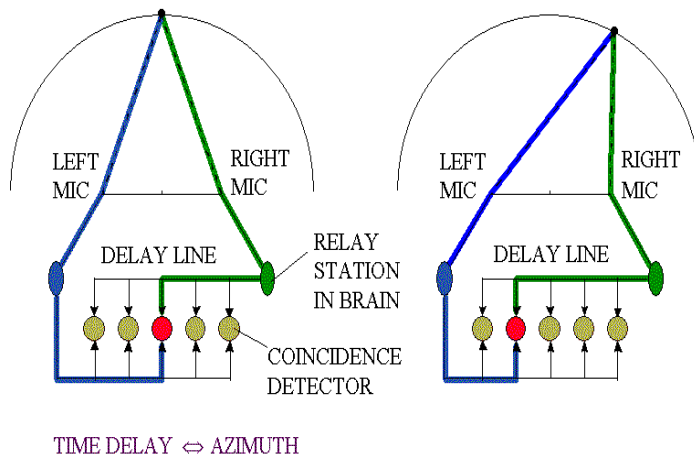


- Separation by Frequency
- Dual Delay Lines
- Identify Source Locations
- Cancel Noise by Steering Nulls



# Algorithm 1:

## Localization and Cancellation



Localization in the Brain

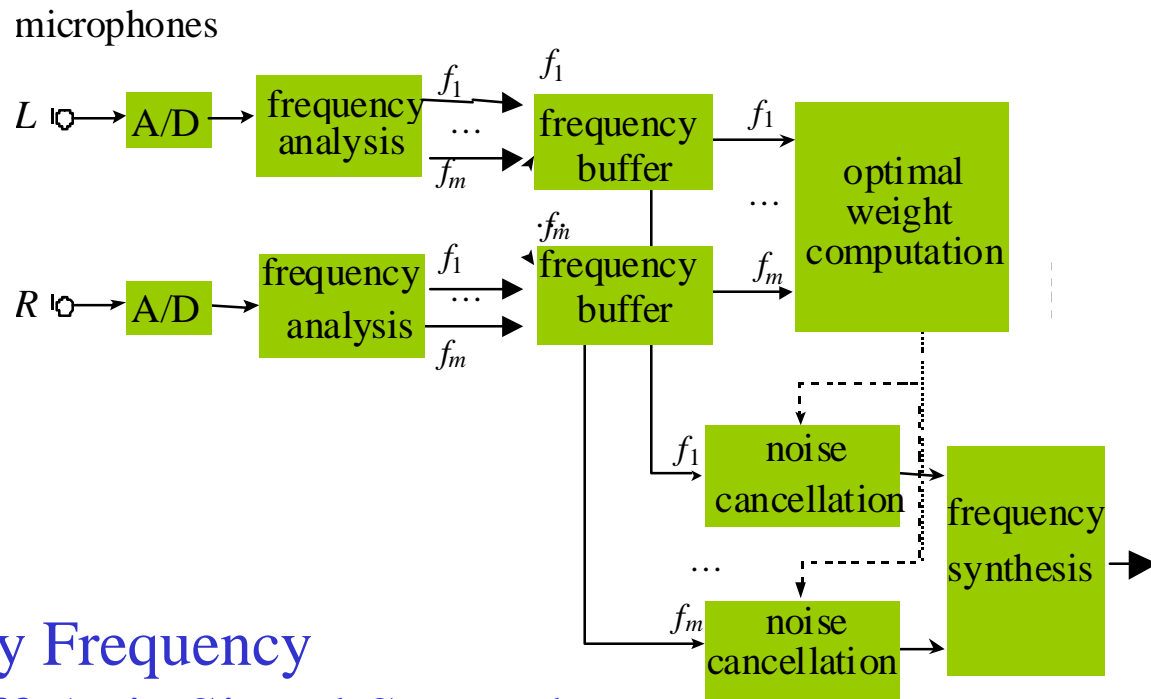
Localization by Computer  
(measure of coincidence vs. azimuth)



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# Algorithm 2:

## Minimum Variance Cancellation



- Separation by Frequency
- Minimize Off-Axis Signal Strength



# Experimental Examples

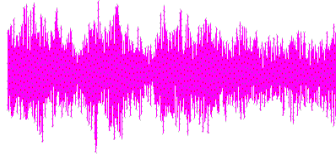
The old train was powered by steam

Target  
@ 0°



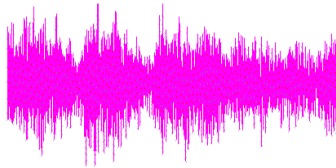
Interferor  
@ 65°

Twelve talker babble



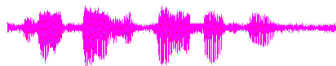
Interferor  
@ 30°

Target  
@ 0°



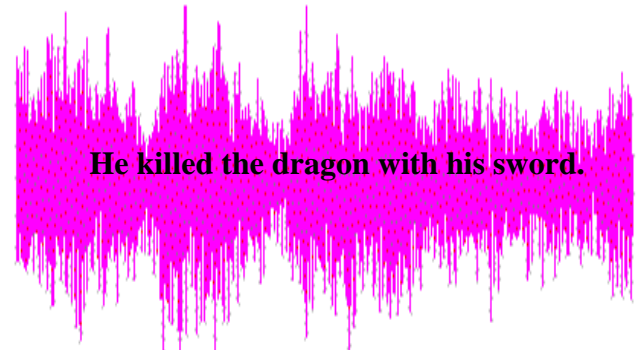
Combined  
Waveform

Interferor  
@ 22°



Reconstructed  
Waveform

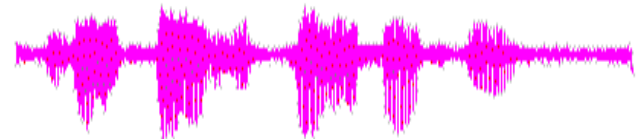
Stir your coffee with a spoon. Stir your



He killed the dragon with his sword.

His plan meant taking a big risk. His pl

Combined  
Waveform



Reconstructed  
Waveform



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# Experimental Summary

(ALGORITHM 2)

Expmnt #	Position Attenuation	Position Attenuation	Position Attenuation	Position Attenuation	Average Gain
1	-75° 4.8 dB	Target: 0° 0.6 dB	20° 4.1 dB	75° 2.1 dB	6.2 dB
2	30° 6.3 dB	-45° 4.2 dB	60° 3.1 dB	Target: -10° 0.6 dB	6.7 dB
3	Target: 10° 1.1 dB	-80° 3.9 dB	-50° 2.9 dB	45° 2.7 dB	4.6 dB
4	-30° 6.3 dB	15° 0.9 dB	Target: 5° 0.9 dB	-60° 3.6 dB	5.3 dB
5	-25° 5.7 dB	Target: 25° 0.7 dB	-70° 4.3 dB	80° 2.9 dB	6.3 dB

Recordings made in a Conference Room

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# Current and Future Work

- **Real-Time Implementation**
- **Microphone Compensation**
- **Dereverberation**

Thanks to Dr. Chen Liu (now at Motorola), Dr. Marc Goeygou (now at U. Lisle) and grad students Mike Lockwood and Mark Elledge



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